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cut in two points, is the only one which as a whole is freely movable in itself.

Then Klein says: "I consider all the topologically distinguished space-forms as equally compatible with experience. That in our theoretic considerations we prefer some of these space-forms (namely, the family types, that is, the properly parabolic, hyperbolic, elliptic) in order to finally assume the parabolic geometry, that is, the customary Euclidean geometry, as valid, happens simply from the principle of economy."

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

*EARTHQUAKE SHOCKS IN GILES CO., VA.**

IMMEDIATELY following the earthquake of May 31, 1897, which was distinctly felt over most of the eastern portion of the United States, came newspaper reports of continued disturbance in the form of explosions and earth tremors in Giles county, Virginia. It was also reported that Mountain Lake had been drained, that the wells of Saltville, Virginia, had ceased to flow, and that large fissures had opened in the earth at various points in Giles county. At the urgent request of several citizens of Pearisburg, and with the idea that possibly there might be some foundation for the rumors afloat, I visited the region in the early part of June. The reports were found to be grossly exaggerated, as no disturbance had occurred at Mountain Lake, the Saltville wells were flowing as usual, and no fissures had appeared within the limits of Giles county. Under the circumstances the scientific results of my visit were insignificant, but there were certain phenomena observed which seemed to be worth recording.

The county of Giles lies on the northwestern side of the Appalachian Valley. Its surface is diversified by numerous ridges

which cross the country from northeast to southwest. The rocks have been thrown into great folds, and are broken by numerous faults which also cross the region in the same direction. The principal object of my visit was to determine, if possible, whether there was any relation between the present disturbance and the geologic structure of the region; but, from the nature of the case, only a little information was obtained on the subject.

The earliest generally recognized earth tremor occurred on May 3. It loosened some bricks from old chimneys and was accompanied by considerable noise, like low rumbling thunder. From May 3 to 31 no shock of importance occurred, but many noises were heard, similar to the rumbling that accompanied the first quake. Many persons now believe that the same sort of noises occurred for a long time prior to May 3, but were passed unnoticed by the people, who, at that time, did not have their nerves wrought to such a tension that they heard and felt the slightest shock or earth tremor.

The shock of May 31 was probably more severe in and about Pearisburg than at any other point from which I have information. No serious damage was done even here, but old brick houses were badly shaken, and many chimneys were cracked and the top-most bricks hurled to the ground. Much noise accompanied this shock, and many of the inhabitants, already much disturbed by the previous heavy shock and the continued rumblings beneath them during the month, were terror-stricken. The noise did not stop with the main shock, but tremors and rumblings, or sharp reports, are described as occurring during the entire night following the shock. The intensity of these rumblings or reports varied according to location. Those of greatest severity were reported from the angle between Sugar Run and Pearis Mountains. Old veterans of the

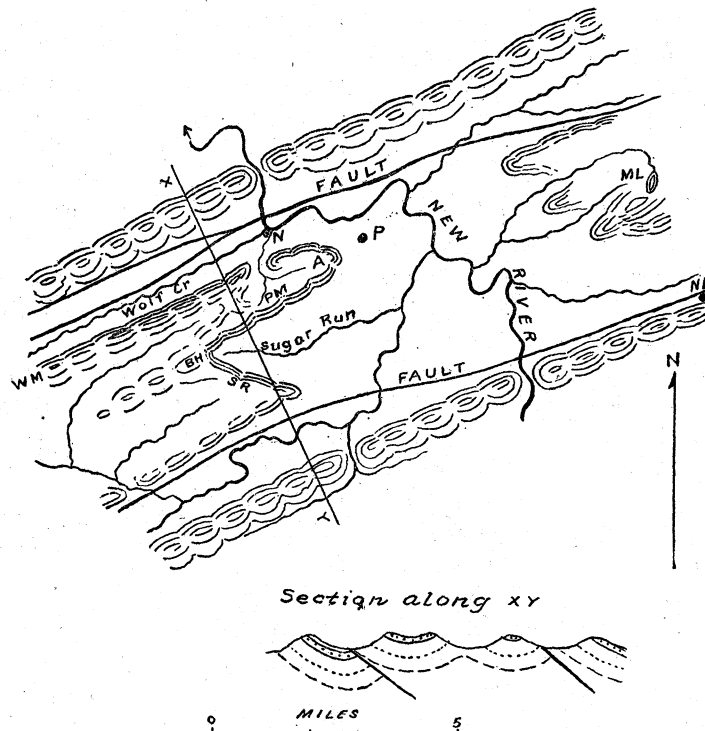
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war likened them to the reports of heavy siege guns fired at frequent intervals during the night.

From May 31 to the time of my visit, on June 6, the explosions are reported to have continued with considerable regularity, from five to ten slight shocks being about the daily average. During my stay of three days at Pearisburg I heard and felt a num-

in intensity and in frequency, until at the present time they are scarcely noticeable. Mr. Shuler estimates that there have been at least 250 distinct shocks observed at Pearisburg since the 3d of May.

The many conflicting reports of the inhabitants regarding the shocks made it almost impossible to arrive at any definite conclusion regarding the relation of the



SKETCH MAP OF THE PEARISBURG REGION.

P—Pearisburg.....	WM Wolf Creek Mt.	A—Angels' Rest.....	SR Sugar Run Mt.
N—Narrows.....	PM Pearis Mt.	NP—Newport.	
	ML—Mountain Lake...	BH Big Horse Gap.	

ber of these explosions and tremors. Ordinarily I should not have noticed most of them, merely supposing them to be distant thunder. But a few were severe enough to jar the windows perceptibly. Since then, according to the reports of Mr. J. A. H. Shuler, the Baptist minister of the town, the shocks have been growing less and less

disturbance to the geologic structure of the region, but a few facts were noted which seem to have a bearing on this interesting question.

Apparently the general shock of May 31st was most severely felt at the Narrows, which is located on one of the most complex and extensive faults of the region.

At this point the surface is said to have rolled like the groundswells of the ocean, springs were muddled and in some cases ceased to flow for a short time after the shock occurred, and a landslide of considerable proportions and a big rock rolled down off the face of Wolf Creek Mountain. The latter is no indication of great intensity, for the slopes of the mountain are so steep that a slide is liable to start at any time, and the blocks of sandstone have frequently such a precarious foothold that they will start with the slightest disturbance.

In the valley of Wolf Creek the testimony regarding the direction from which the explosions came is conflicting. Some thought that they came from immediately beneath, and some were equally certain that they came from the south—from the base of Wolf Creek Mountain. At Pearisburg there is a general agreement that the sounds and shocks always came from the west, or from the base of Angels' Rest. The shocks which I experienced at Pearisburg seemed to come from a little north of west, or from the direction of the Narrows, and they also appeared to come horizontally. In the Sugar Run region the general verdict was that they came from the north—from under Pearis Mountain, or from the west—from Big Horse Gap. In the vicinity of Pearisburg and Sugar Run the springs were disturbed, but not to the same extent as in the valley of Wolf Creek.

Pearis and Wolf Creek Mountains represent the two sides of a syncline whose point is formed by Angels' Rest. The strata of this basin are only slightly flexed, and it seems strange that it should be the seat of earth tremors. But when it is considered that the great fault along Wolf Creek valley dips toward the south at about 30 degrees it will be seen that the syncline is comparatively shallow and overlies the plane of the fault. Therefore, it seems probable that, instead of originating in the

mountain proper, the disturbance came from movement along the fault plane underneath the mountain.

Movement along this fault plane is the only hypothesis I could formulate to account for the phenomena, but if such movement occurred it must have been so slight as to be unrecognizable at the surface. The reason for the pronounced disturbance in and about Pearisburg is presumably the cavernous condition of the limestone in that region, apparently causing it to act as a sounding board, magnifying the sounds and vibrations. Newport is also reported to have suffered considerably from the shocks; this can be accounted for by the hypothesis of movement on the fault, on which it also is located.

M. R. CAMPBELL.

WASHINGTON, D.C., December 18, 1897.

BOTANICAL NOTES.

DISTRIBUTION OF GOVERNMENT BOTANICAL PUBLICATIONS.

It may not be generally known that there are many valuable publications from the several botanical divisions of the Department of Agriculture which may be obtained gratis or by the payment of a merely nominal sum. The Superintendent of Documents has issued a handy list of the publications now in his hands, with prices affixed. It will well repay every botanist not regularly receiving these publications to look over this list and secure valuable books and papers for but a slight cost.

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